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Business model adaptation in new ventures: are technology-based firms different?

ABSTRACT

A firm's business model (BM) is an important driver of its relative performance. Constructive adaptation to elements of the BM can therefore sustain the position in light of changing conditions. This study takes a configurational approach to understanding drivers of business model adaptation (BMA) in new ventures. We investigate the effect of human capital, social capital, and technological environment on BMA. We find that a universal, direct-effects, analysis can provide useful information, but also risks painting a distorted picture. Contingent, two-way interactions add further explanatory power, but configurational models combining elements of all three (internal resource, external activities, environment) are superior.

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Keywords: Business model; adaptation; technology; human capital; social capital; configuration

Track: Entrepreneurship; also relevant to Innovation.

INTRODUCTION

Getting the business model right is "of exceptional importance to managers" (Baden-Fuller, Demil et al. 2010: 143), because it makes an important contribution to the firm's economic performance (Malone, Weill et al. 2006; Zott and Amit 2007; Zott and Amit 2008). Hence purposeful business model adaptation (BMA) can provide competitive advantage and lead to superior performance or ensure survival (Andries and Debackere 2007; Björkdahl 2009), in the face of changing market conditions (Teece 2007 ; Teece 2010) or internally driven changes (Chesbrough and Rosenbloom 2002).

The introduction of new technologies, or other innovation, often also needs a business model different to the mainstream in order to be successful (Chesbrough 2007; Björkdahl 2009). This requires either adapting elements of the extant business model (Björkdahl 2009) or running multiple business models within the organisation (Markides and Oyon 2010). Developments in very mature markets can also erode the value of existing business models, hence require adaptation by incumbents (McGrath 2010; Sabatier, Craig-Kennard et al. 2012). Firms that decide to adapt then navigate a process of experimentation (Chesbrough 2010; Doz and Kosonen 2010; Sosna, Trevinyo-Rodriguez et al. 2010). Through experimentation, they learn, whether by assessing the outcomes of their own investments, or from competitors' moves in the marketplace (McGrath 2010).

Past research tells us that not all firms adapt successfully, nor even commence a process of adaptation (Linder and Cantrell 2007; Bock, Opsahl et al. 2012). Large established firms have difficulty adapting, possibly due to specificity of the business model. One very important study found "no significant relationship between prior change success and business model innovation efforts" which tells us that the lessons learnt elsewhere might be difficult to transpose to the business model (Bock, Opsahl et al. 2012: 296). Past research on the business model is generally nonaccretive and either descriptive or only incidentally covers adaptation (Sosna, Trevinyo-Rodriguez et al. 2010; George and Bock 2011; Zott, Amit et al. 2011).

Previous studies on business model adaptation are based on case studies of large established firms. Yet, the entrepreneurship literature has highlighted distinctive features of new ventures. They "exist in stark contrast to the larger incumbents in an industry" (West and Noel 2009: 5) display greater flexibility and speed of execution, relying heavily on founders' prior market knowledge (Nicholls-Nixon, Cooper et al. 2000 ; West and Noel 2009). Similarly, past

research on business models also suggests that adaptation "may proceed differently in start-ups compared to established organizations" (Sosna, Trevinyo-Rodriguez et al. 2010: 403.) In addition, Chesbrough and Rosenbloom (2002: 552) posit that "adaptation appears to be either more highly motivated or more easily implemented in independent [ie spinout/SME] ventures than in established firms." There are very few systematic quantitative studies in the literature (examples: (Bigliardi, Nosella et al. 2005; Malone, Weill et al. 2006; Zott and Amit 2007; Zott and Amit 2008; Bock, Opsahl et al. 2012)). They are sectorally based and the one study where business model innovation is important (Bock, Opsahl et al. 2012) treats it as a moderator between structural reconfiguration and structural flexibility, rather than the dependent variable. Thus, theory based research on business model adaptation in new ventures is particularly underdeveloped.

Research on the business model has also moved beyond a focus on e-business (Mahadevan 2000; Afuah and Tucci ; Amit and Zott 2001; Weill and Vitale 2001) to other sectors such as biotechnology (Bigliardi, Nosella et al. 2005; Pisano 2006; Rothman and Kraft 2006; Willemstein, van der Valk et al. 2007). Indeed, Malone et al (2006) conducted a wide-ranging empirical study of *all* publicly-traded US companies, during which they found that business model "is a useful construct and can predict performance." (Malone, Weill et al. 2006: 4.) Individual studies, however, do remain narrowly focussed (Patzelt, zu Knyphausen-Aufse et al. 2008: 217):

> ... we would also like to encourage business model researchers to extend their attention beyond the e-business and internet industries, on which most studies have focused so far

An important question, therefore, is how to broaden the research base, yet still be able to make meaningful, rich comparisons across sectors and environments. Adopting a universal approach, with direct relationships between explanatory variables and BMA can certainly broaden the perspective. It can generate high level theory.

Although understanding universal relationships in business is useful for the development of theory and practice, on its own it risks missing important idiosyncrasies relevant to particular circumstances and people. This can lead to incorrect or unbalanced recommendations and investments. Contingency relationships, for example, exploit synergies between variables that might not occur when those variables apply in isolation.

Certain configurations might be effective across various environments (Ketchen, Combs et al. 1997), yet different configurations can be found in any given environment (Black and Boal 1994), reflecting their equifinality (Doty 1993). Further, the fit of various configurations of internal and external

factors can draw out valuable contributions from forces that appear irrelevant even in contingent analysis. Systems and the potential configuration of elements within them can add to causal ambiguity (Reed and De Fillippi 1990) and provide the foundations for competitive advantage (Eisenhardt and Martin 2000) partly through "surprising, emergent behavior that can be understood through formal models" (Anderson, Meyer et al. 1999: 233). Hence appropriate fit of the various elements is hypothesised to enhance firm performance, possibly on a sustained basis (Porter 2008):

> [C]ompetitive advantage may reside in the orchestrating theme and integrative mechanisms that ensure complementarity among a firm's various aspects: its market domain, its skills, resources and routines, its technologies, its departments and its decisionmaking processes.(Miller 1996: 509)

Configurations require systems thinking. Despite its long tradition (Miller 1987; Doty 1993), configuration research has only recently experienced a resurgence of empirical studies and appears in different management disciplines, such as human resource management, strategy, information systems, and entrepreneurship (eg (Wiklund and Shepherd 2005; Stam and Elfring 2008; Visser 2010; Ridder, Baluch et al. 2012; Zimmermann, Raab et al. 2013))

This study validates configurational theory. It does so by investigating different forms of human capital, various external orientation activities and levels of technology intensity in relation to the degree of business model adaptation in new ventures: do combinations matter? In The very process of testing these relationships allows comparisons with universal and contingency models.

Configuration approach holds scope for bridging the gap between researchers and practitioners (Markides 2007; McGahan 2007). By considering combinations of elements, we get closer to the situation of individual firms and practitioners hence develop recommendations that can be more easily and usefully implemented. By the same token, any configurational model would have relatively more limited scope for application. It develops middle range theory.

In light of the strong research tradition that focuses either on external environment (Porter 1998; Porter 2008) [Hannan & Freemen, 1977] or on internal resources (Peteraf 1993; Teece 2007; Bradley, Aldrich et al. 2011), the tight resource constraints on new ventures (Stinchcombe 1965; West and

Noel 2009), and the importance of the interface between inner and outer environments (Sarasvathy 2004), we assess configurations of environment, internal human capital and the firm's external orientation.

We contribute to filling these gaps by generating methodologically sound longitudinal observations. We take an organizational learning perspective, in new ventures. In particular, the main research question for this study is: How do configurations of different aspects of social capital and human capital, in different technology environments, impact on business model adaptation in new firms across the economy? By answering this question, our work makes several contributions to the literature. First, we add to the organizational learning literature. We apply human capital, social capital and configuration theory to view business model adaptation as a phenomenon reflecting organizational learning. Second, we contribute new knowledge to the research task of understanding what factors facilitate or impede business model adaptation. We do so in the entrepreneurship context. And we apply statistical evidence based on a large economy-wide panel study. We are not aware of such an approach in the top academic outlets. Finally, we expand their boundary conditions for the theory of human capital and social capital by applying them to the new research topic of the business model. We provide partial support for their interactive effect, which is often hypothesised but rarely reported. We discover configurational effects of variables that appear insignificant in universal or contingent analyses.

The paper proceeds as follows. First, we review relevant literature on organisational learning and social and human capital to develop hypotheses of universal, contingent and configurational scope. Then, we outline our method and present our results. This is followed by a discussion of implications for theory, practice and further research.

THEORY AND HYPOTHESES

There are four broad schools of organisational learning: economic, developmental, managerial, and process (Bell, Whitwell et al. 2002). The economic view has tended to focus on learning curves, or experience curves, where cumulative experience in production processes can bring cost savings. It is mostly backward looking, often relying on past success or failure as a source of learning (McGrath 1999; Minniti and Bygrave 2001). The developmental approach sees organisations taking a pro-active learning attitude, as in the dynamic capabilities literature. It theorises that learning changes in manner and content, based on age and size (Sinkula 1994), as well as the history of the organisation (Cohen and Levinthal 1990; Shane and Venkataraman 2000). For example

> ... typically, newly conceived organizations possess congenital knowledge that focuses on generalized, rationalized concepts of how markets work with less situation-specific knowledge than they would desire, because such knowledge often comes only with trial and error. (Sinkula 1994: 38)

In the managerial school, the organisation sets up systems, processes or a culture to foster learning. Finally, the processing school of thought highlights the importance of individuals, such that different groupings of individuals will lead to different learning patterns (Brown and Duguid 1991; Ployhart and Moliterno 2011). This study proposes the developmental perspective as being more closely aligned to business model adaptation processes in new ventures.

In this section, we develop the conceptual model depicted in Figure 1.

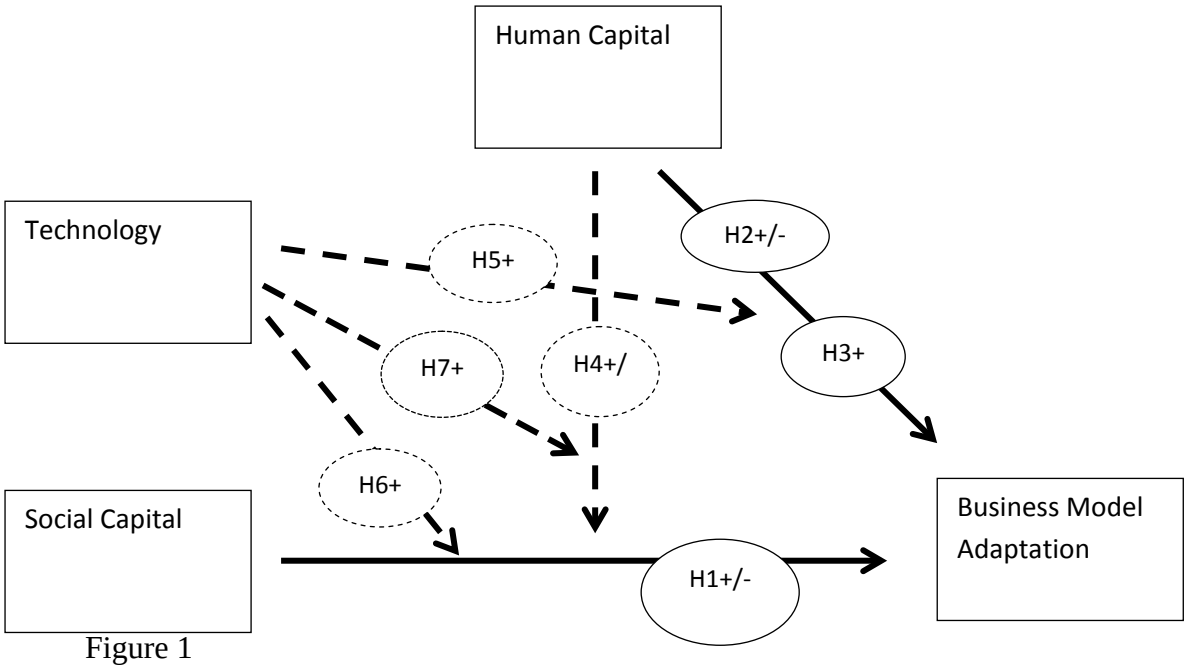


Figure 1

Figure 1.

Social capital

Social capital can enhance organisational advantage through its effect on learning (Brown and Duguid 1991; Nahapiet and Ghoshal 1998) especially for

managers “with few peers” within the firm (Burt 1997: 345). This is the situation often found in new ventures struggling with the liability of newness (Stinchcombe 1965). Discussions about social capital distinguish between strong, bonding ties and weak, bridging ties in one’s networks.

Bridging ties connect individuals to networks with which one has relatively few interactions, where the sense of common purpose is fairly diffused. Information flows tend to be slower, but can reach out more broadly making them a more useful means of collecting and disseminating novel ideas and practices (Rogers 1962). Useful bridging ties can accelerate learning especially when markets or technologies are uncertain (Teece 1996), or the young firm has limited accumulated human capital (West and Noel 2009).

Bonding ties occur when there are high levels of camaraderie and trust (Becker and Murphy 1992; Cope 2011). Information flows rapidly, and there is strong positive reinforcement of behaviour (Sobel 2002). This can lead to excessive reliance on internal communication hence impede adaptation (Kautonen, Zolin et al. 2010). That said, networks from personal life (bonding ties) can interact with those from more arm’s length business relationships (bridging ties) (Payne, Moore et al. 2011) and help integrate new material discovered through bridging activities into the firm’s thinking and into action (Tiwana 2008). This occurs because the stronger bonding ties carry a higher degree of trust and common understanding of history and objectives.

Because of the relative lack of rigorous academic research on the topic, discussion around business models and their adaptation is more likely to be heard in business-related networks. In fact, there exist online networks devoted to discussing issues related solely to business models. Social capital exposes the firm’s members to new ideas and actions. The entrepreneur can learn about different business models that are better suited to the firm’s desired outcomes. They can also learn about how to implement business model adaptation effectively. These are particularly important contributions that social capital can make to constructive business model adaptation.

We therefore hypothesise

- H1a With greater component of family and friends in the new venture founding team, business model adaptation will fall
- H1b Greater use of network connections of the bridging type will lead to greater business model adaptation
- H1c Having more family and friends in the founding team will facilitate the translation of ideas gained from bridging ties into business model adaptation

Human capital

Human capital is both an important driver and recipient of organisational learning. It comprises "the resources in people" (Becker 1964: 1) and is typically taken as the accumulated stock of knowledge from certified and experiential learning (Arrow 1962; Brown and Duguid 1991). Past research has found that prior stock of knowledge allows learning to occur from new information. The uneven distribution of such stock across the economy impacts on how the information is processed and on entrepreneurial outcomes (Shane 2000; Davidsson and Honig 2003). These higher cognitive abilities should also facilitate business model adaptation. There are three main steps in the process.

First, a firm with greater human capital should be better able to process and absorb new data or information regarding mismatches between its business model and its desired market status. Second, it should be better able to reach a conclusion about improvements to the business model. Third, it should better convert knowledge into action, for a closer match of the firm's business model with the market it aims to meet. Empirical evidence on the relationship between human capital and returns is not uniform. In the entrepreneurship literature, it has been found to relate differently to economic performance (Haber and Reichel 2007), dynamic capabilities (McKelvie and Davidsson 2009), or creation vs exploitation in new ventures (Davidsson and Honig 2003). As a result, there is need for greater granularity in deploying the concept (Dimov and Shepherd 2005; Delmar and Shane 2006).

We have broadly explicated how human capital should impact upon business model adaptation. In his seminal work, Becker (1964) distinguished between generic and specific forms of human capital. Generic human capital can be applied across domains with low switching costs and loss of returns (Becker 1964; Reed and De Fillippi 1990). Specific human capital is less easily transferred, precisely because its value is more specific to particular settings. We now draw hypotheses based on these theoretical categories.

Greater depth and breadth of *generic human capital* enhances the ability to learn. Through this mechanism, it provides a larger platform on which to attach stimuli from disparate sources, hence affords the capacity for more radical, or swifter adaptation (Marvel and Lumpkin 2007). Broad understanding of market dynamics helps, because:

> ... firms that develop a higher-quality stock of context-generic human capital also may be more able to adapt ... to environmental dynamism and change (Ployhart and Moliterno 2011: 143)

For example, greater exposure to international cultures and markets through periods of work or study abroad can open one's mind to different ways of behaving. This can have a lasting effect on the firm's actions (Autio, Sapienza et al. 2000). More years of general management experience provide a more diverse palette of experiences from which to recognise new patterns or opportunities (Marvel and Lumpkin 2007). On the other hand, prior experience in large, established firms could be detrimental to the extent that new ventures are different, as previously discussed. The executive with large corporate experience will be used to having resources and established structures and routines as a support base, hence especially struggle with the liability of newness. We therefore hypothesize:

H2a Owners' greater generic human capital in the form of international experience and general management experience will lead to greater business model adaptation in new ventures

H2b Owners' prior managerial experience in large, established corporations will reduce business model adaptation in new ventures

H2c Higher levels of generic education in the leadership team will increase business model adaptation in new ventures

Because of its closer relevance to particular circumstances, *specific human capital* is likely to have more immediate impact on behaviour and performance. In the context of this study, specific human capital can be defined to include any elements that could help the new venture recognise the desirability of business model adaptation and bring it to fruition.

Formal classes in business disciplines make up the education component of specific human capital. Theories from these disciplines can provide parsimonious frameworks within which to analyse, process and convert data and information into knowledge and action. This might be of limited value for two reasons. First, the novelty of the business model concept in academic research means there is very limited theory specifically developed to aid design and adaptation of business models (McEvily, Das et al. 2000). Second, the unifying nature of the business model makes it difficult for research and teaching to cross the disciplinary boundaries (Chesbrough and Rosenbloom 2002). The entrepreneur and their helpers would therefore need to re-interpret their business and managerial related education for business model purposes.

Various forms of experiential learning can add to specific human capital. Time spent in the same market space, will expose one to idiosyncrasies that would take a new comer longer to discern (Marvel and Lumpkin 2007; West and Noel 2009). As a result, experience in the specific industry of the current venture can allow greater capacity to maintain a venture alive for longer, if the entrepreneur can learn and act upon the learning (Shane 2000). Owners' prior

entrepreneurial experience contributes to specific human capital, because of the distinctiveness of new ventures. Over time, decisions that have produced successes would be repeated and those that produced failures would be discarded (Minniti and Bygrave 2001). Enacting adaptation in a new venture might then depend on whether the decision maker's specific business experience comes from other start-ups or from more established firms (West and Noel 2009).

Relevant knowledge may be distributed across an organisation (Brown and Duguid 1991). It is therefore important that human capital embodied in its members be accessible to the firm. In other words, an employee's experience can contribute to the firm's learning, if the new venture can draw upon it. This is especially relevant to early stage firms relying on few and unsystematised resources (McKelvie and Davidsson 2009; Bradley, Aldrich et al. 2011).

All these forms of experiential learning can also create a dominant logic that inhibits adaptability (Leonard-Barton 1992; Burgelman and Grove 1996; Pennings, Lee et al. 1998). Further, Delmar and Shane (2006) show that different forms of experience can have different effect on various measures of new venture performance. We therefore test:

- H3a Higher levels of specific education are associated with greater business model adaptation in new ventures
- H3b More same-industry experience will lead to greater business model adaptation in new ventures
- H3c Owners' participation in a larger number of prior start-ups will lead to greater business model adaptation in new ventures
- H3d Having access to greater specific human capital in the form of owners', employees' and other non-owner helpers' work experience that contributes to specific business functions will increase business model adaptation in new ventures

Interaction between human capital and social capital

Past research hypothesises complementarities between human and social capital (Nahapiet and Ghoshal 1998; Ployhart and Moliterno 2011). It follows that their interaction might also have an impact on business model adaptation. When entrepreneurs discover a new business model through their network, they need the capacity to analyse its value for their own situation and to implement any decision they take. A greater stock of human capital will help gain more value from the social capital than lower levels of human capital. Therefore, we hypothesise

H4a There is a stronger positive relationship between bridging social capital and business model adaptation for those with high levels of human capital than for those with low levels of human capital

H4b There is a weaker negative relationship between bonding social capital and business model adaptation for those with high levels of human capital than for those with low levels of human capital

Interaction of technology environment with human capital and social capital

In contrast to the mainstream, new technology-based firms (NTBFs) operate in fast-moving markets, where a dominant paradigm is unclear (Eisenhardt and Martin 2000) and requisite technical knowledge is broadly distributed (Teece 1996).

NTBFs have become progressively more important drivers of economic activity (Mohr 2001; Wirtz, Mathieu et al. 2007; Bruni and Verona 2009) and requires different thinking (Eisenhardt 1989; Beckman, Eisenhardt et al. 2012). Technology itself can be a source of fluidity and uncertainty. It therefore adds an extra dimension of risk: market and technology risk (Chesbrough 1999; Chesbrough and Rosenbloom 2002). This attaches a greater premium on human capital relevant for understanding both market trends and technology trends. It is important for internal decision makers to bring these two worlds together, in order to improve investments and the firm's positioning (Burgelman and Grove 1996; Corolleur, Carrere et al. 2004; Gittelman 2007.) Burgelman and Grove (1996) recount the case of how salespeople, who were in closer connection with the market were able to induce better decision making than senior management. Eisenhardt and her collaborators (Bourgeois III and Eisenhardt 1987; Eisenhardt 1989; Eisenhardt and Tabrizi 1995) found that fast-cycle decision making was a crucial differentiator in the computer industry. Those decisions, however, also needed to be of high quality. That was achieved through ongoing information gathering and analysis from market interaction. Gittelman (2007) found that social interaction between scientists can facilitate market outcomes:

> … results indicate that technical and scientific knowledge adhere to different geographic and social logics and that firms seeking to profit from science face trade-offs in managing these different activities (Gittelman 2007: 738)

Prior entrepreneurship research has found direct positive association of SC and HC with successful outcomes in NTBFs (Taheri and van Geenhuizen 2011; Ganotakis 2012). NTBFs can learn from each other, often taking small continuous steps in the BMA process (McGrath 2010). We therefore hypothesise:

H5 The relationship of SC and HC with BMA is positively moderated by technology intensity

Configuration effect of technology environment, human capital, and social capital

On the other hand, research has found no difference between technology and mainstream environments (Unger, Rauch et al. 2011). This is often considered to be due to broad theorising and operationalisation of constructs. The implication is that other moderating factors might be at play. Therefore, greater granularity in theorising and empirical investigations of both SC and HC are required (Dimov and Shepherd 2005; Delmar and Shane 2006; Stam, Arzlanian et al. 2013).

"It would further be interesting to investigate three-way-interactions" (Unger, Rauch et al. 2011: 353) to understand the value of configurations in different contexts (Johns 2006; Zahra 2007; Short, Payne et al. 2008). For example, if hi-tech environments reward BMA, we should expect a firm's superior SC/HC mix to be even more important than for the mainstream. Lower quality configurations might also be possible. SC activities require time and effort. They can add operational complexity and require increasing personal attention by the founder-entrepreneur (Sullivan and Marvel 2011). If market-relevant information discovered via SC is processed via inadequate HC, it could be detrimental. Further, it could also be less useful in lo-tech environments, as they do not reward BMA so much.

H6a. BMA is explained by configurations of SC, HC and technology environments
H6b. BMA is highest among firms with high HC and SC, in hi-tech environments
H6c. BMA is lowest among firms with high SC and low HC, in lo-tech environments

METHODS

Source of data

Data are drawn from the Comprehensive Australian Study of Entrepreneurial Emergence (CAUSEE) which adopts a methodology developed by the Panel Study of Entrepreneurial Dynamics (PSED) (Gartner et al. 2004; Reynolds 2007). Telephone contact of a random sample of 30,105 households in Australia, generated 1,186 new ventures in its first wave (Davidsson, Steffens et al. 2008). Interviews were conducted repeatedly over four years. In wave four, 382 respondents were asked questions about their firm's business model.

This design deals with two important sources of selection bias. First is the danger of sampling from an incomplete population, or a non-random selection of a complete population (Martinez 2011) say, when using public registers, because not all new ventures are recorded. The second source is sampling on the dependent variable (eg successful firms, to find sources of success) or when using selected empirical settings (eg a particular industry) (Denrell and Kovács 2008).

These problems can be solved by sampling the entire population of households and by following events longitudinally (Denrell and Kovács 2008; Martinez 2011). Both practices were adopted for this study. We have temporal separation of dependent and independent variables (Scandura and Williams 2000) and varied question type over a lengthy interview (Podsakoff, MacKenzie et al. 2003), in a theory-based model. Thus, our design aids inferences of causality.

Measures

Dependent variable

The survey script instructed interviewers to introduce the business model thus

> I would now like to ask some questions about the characteristics of your 'business idea', or 'business model'. By 'business idea' and 'business model' we here mean your core ideas about things like What you are going to sell; who you will sell it to; how you will sell it, and how you will acquire or produce what you are going to sell.

In waves 2-4 we also asked about adaptation of the elements of their business model:

> For each of the following statements I would like to know whether there has been any *important change during the last 12 months* and, if so, roughly how many changes there have been of that kind. [emphasis in original]

Possible answers ranged from No/0 to Yes/5+. We drew our dependent variable from the answers to wave four. We aggregated the number of changes for each element of the business model. The raw data were then augmented by 1 and a log-normal transformation taken.

Independent variables

Human and social capital were operationalised using variables for each theoretical category (ie generic/specific, bridging/bonding.) Some are formative measures (Leonard-Barton 1992) constructed as a combination of several items in the database, typically as an index consisting of a count of the relevant components (McKelvie and Davidsson 2009). Others are single item measures. Observations were mostly taken in wave one, with some from wave two.

We asked questions about the ownership team's collective *generic experience*: years of general management experience; whether anybody had worked in management in a large corporation for more than a year (dummy variable); number of countries in which all owners had either worked or studied as an adult for a period greater than three months. Our measure of *generic education* is the percentage of owners with any postsecondary qualification.

Questions relating to the ownership team's collective *specific experience* asked about: number of years in the same industry as the current new venture; number of prior start-ups created as owner or part-owner. Further, we constructed an index to capture how the firm's prior work experience was useful to the new venture. Respondents were asked whether, on the basis of work experience, they or any other owner could help the business across five functional areas. For the same functional areas, we asked if any other unpaid, non-owner helpers had made "important contributions." In wave 2, we also asked whether employees or other paid helpers had made important contributions in the same areas, during the previous year. Similar variables have been labelled Business Skills Index (Haber and Reichel 2007) or comprehensiveness of knowledge (Sullivan and Marvel 2011) but generally denote a larger stock of human capital, the higher the index count. This firm work experience index has a range of 0-20.

To measure *specific education*, we asked whether any of the owners could help the business in certain areas, based on their education and training. These were the same business functions as in the measure of firm work experience. An index was created, with a range of 0-10.

We adopted one measure of bonding ties and two of bridging ties.

Bonding ties typically relate to family and close, long standing connections (Davidsson and Honig 2003; Cope, Jack et al. 2007). We therefore asked respondents if any two owners were related by marriage or blood, were friends from work or social environments, or were otherwise strangers. This generated a count index ranging 0-4 with an extra count for each form of bonding tie.

Important forms of *bridging ties* consist of connections in networks that are explicitly business related (Davidsson and Honig 2003). We have adopted this method and created an index counting membership of face-to-face and online business networks, industry groups/associations, as well as aspects of international activities. The index ranges 0-6. As well as asking about membership of networks, which can be a passive activity, we sought information about possible sources of information and advice that had been "*not used at all*; a *minor* source; or a *major* source" [emphasis in original]. To compile this external advice index, we listed fourteen potential sources, ranging from employers or colleagues to customers and business media.

To measure the technology e*nvironmental context* we asked a series of questions. First, we asked if the firm had applied for intellectual property (IP) protection and we asked if they had developed proprietary technology/processes. From those questions, we created a dummy variable (IPDAYN) taking the value of 1 if either an application or development had occurred. We then asked if the firm considered itself to be hi-tech. Finally, we asked if R&D was a major business priority for the firm. We took the first measure as our technology variable and adopted the others for supplementary robustness checks.

As *control variables* we used age, gender, product/service dummy, and technology/innovation intensity. We asked the age of the youngest and oldest partners. To capture gender effects, we took the proportion of female partners in the ownership team. The product/service dummy was based on whether respondents considered the firm's offering to be mostly a product or service.

Statistical procedure

Hierarchical multiple regression analysis was conducted to test the hypothesised relationships. Contextual variables, direct effects, and interaction terms were entered as separate steps in the analysis, in order to determine the impact of each as a group. We ran all two-way interaction options before entering the relevant three-way interactions. We report unstandardised regression coefficients, when the variables first enter the regression. The linear multiple regressions indicate how much of an impact the independent variables have on the respective dependent variables (Hair, Black et al. 2010).

Before testing for interaction effects, we centered the respective variables on their mean (Jaccard, Wan et al. 1990). We then entered into the moderation step of the regression a cross-product of the hypothesised predictors and moderators (Frazier, Tix et al. 2004). In the equations testing for moderation effects, all variables are centered on their mean.

There are several ways of describing and analysing configurations empirically. Examples are cluster analysis (Salimath, Cullen et al. 2008), three-way interactions in hierarchical regression (James Jaccard, Robert Turrisi et al. 1990: moderated moderation), or ANCOVA and binary logistic regression (Hill and Birkinshaw 2008). We adopt the hierarchical moderated regression route. First, we test the direct, universal relationships of our independent variables to business model adaptation. Then, we partial out all possible two-way interactions. Finally, we test the three-way interaction of our variables against lagged business model adaptation. We retain variables that were not significant in the universal and contingency models, because they might interact significantly in the three-way moderation (Delery and Doty 1996; Wiklund and Shepherd 2005).

We conducted the analysis in five main models, one for social capital and one each for the four theoretical components of human capital. This was to obviate multicollinearity problems (Chandler, McKelvie et al. 2009). The results are shown in Table 1. To save space, we do not show the coefficients for each interaction variable, but report the change in R^2 for the respective step in the hierarchical regression.

RESULTS

The results of our moderated hierarchical regressions are in the Appendix. We ran five models. There was one for the social capital variables. We ran four human capital models, based on the theoretical categories adopted in this study. The F-statistic for every model was highly significant.

The group of control variables was significant. This was entirely due to the product/service dummy: product firms displayed greater adaptation.

H1 related to bonding and bridging ties. H1a was not supported, as our bonding variable was insignificant. H1b was supported, both measures of bridging ties having a positive association with BMA. We hypothesised a positive interaction between bonding and bridging ties in H1c. On both occasions, the coefficient was negative (contrary to the hypothesis) but only marginally significant for the interaction with external advice.

We had three hypotheses for generic human capital under H2. H2a was supported: both international experience and general management experience were positively associated with BMA. Contrary to H2b, prior managerial experience in large, established corporations was positively associated with BMA. The effect of our generic education variable was insignificant: H2c not supported.

Specific human capital was the subject of H3 that received partial support. H3a hypothesised that business education would be positively associated with BMA. That was not supported. Similarly, same-industry experience had no effect on BMA: H3b not supported. H3c was supported. Participation in a larger number of prior start-ups was positively associated with BMA. In H4 we hypothesised that the human capital embodied in members of the firm other than the owner/founders would be positively associated with BMA: supported.

Overall, there was partial support for the hypothesised universal relationships. Contingency relationships were covered in H4 and H5.

The hypothesis that the positive effect of bridging social capital would be amplified with greater human capital (H4a) received limited, marginally significant support. Same industry experience affected both measures, and large corporate experience moderated external advice. On the other hand, the negative moderation with bonding, hypothesised in H4b, was supported for same-industry experience, firm specific human capital, and large corporate experience.

In H5, we hypothesised that technology environment would positively moderate the effect of social capital and human capital. Only one interaction was statistically significant, the one with external advice. It had a negative coefficient, contrary to the hypothesis: rejected.

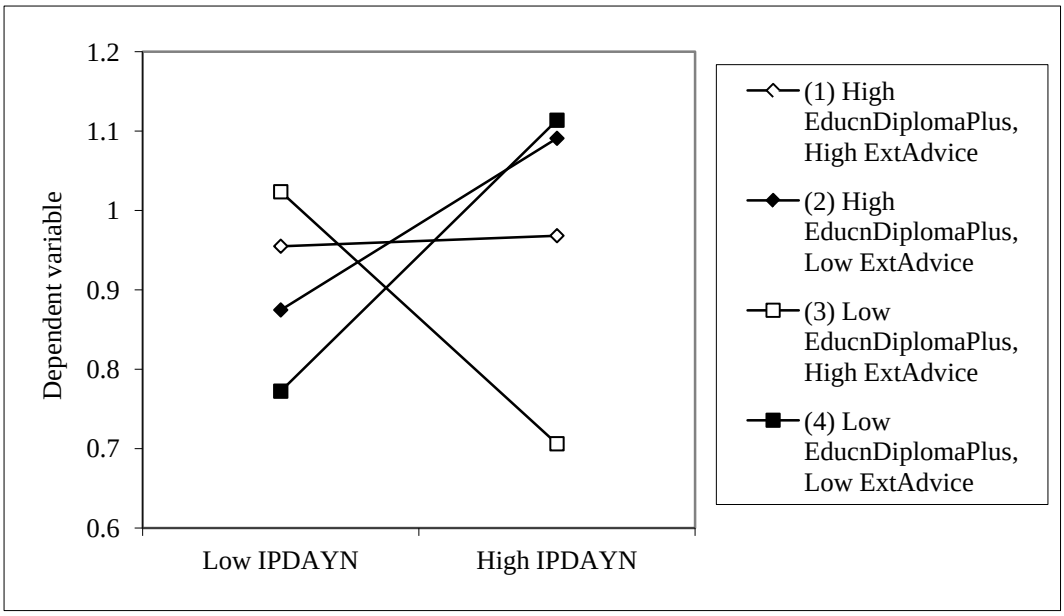
H6a was supported. We found statistically significant configurations for four of the eight measures of human capital. In one case, prior start-up experience, bonding social capital was relevant. In the case of experience in general management, the networking variable GlobalSC was relevant. External advice was relevant for two forms of HC: international experience and education levels. All three social capital variables were part of a significant configuration. Three of the four broad human capital categories had an element in a significant configuration.

H6b was mostly rejected. Of the four significant configurations, only in one case was the highest BMA a combination of high IPDAYN, high HC, and high SC: start-ups and bonding. In the other three cases, the highest BMA occurred with either mixed levels of HC and SC, or indeed low levels of both

education and external advice. They were, however, all in the high technology environment.

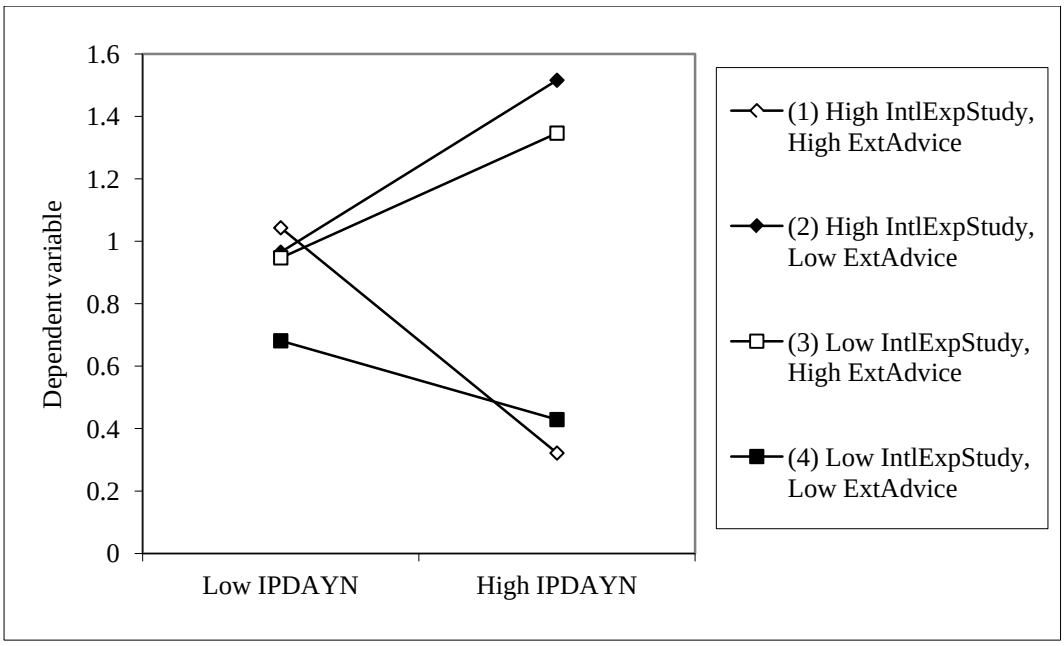
H6c was rejected. Invariably, the lowest levels of BMA were in the high technology environment.

In order to understand better the nature of the significant configurations of variables, we ran simple slope plots with high and low levels of the items within the interaction terms. We took high and low to be ± one standard deviation from the mean, or 1/0 in the case of dummies.

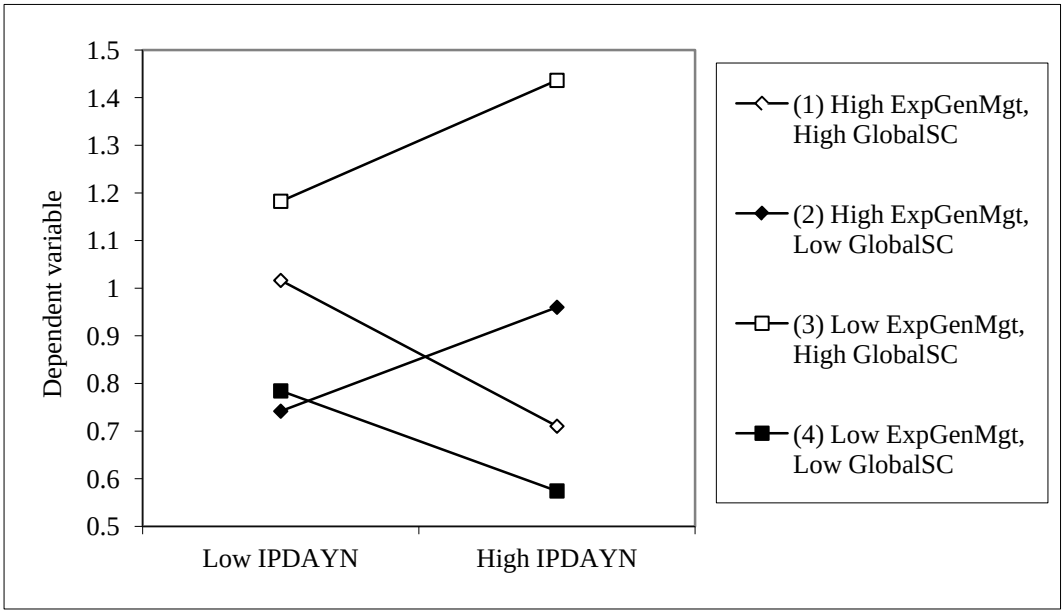


Environment seemed to matter less than level of external advice. For example, BMA increased in higher IPDAYN firms, if they had lower levels of advice, but remained stable or fell with higher levels of advice. Perhaps the external advisers help 'get it right' more from the outset, or are consistently

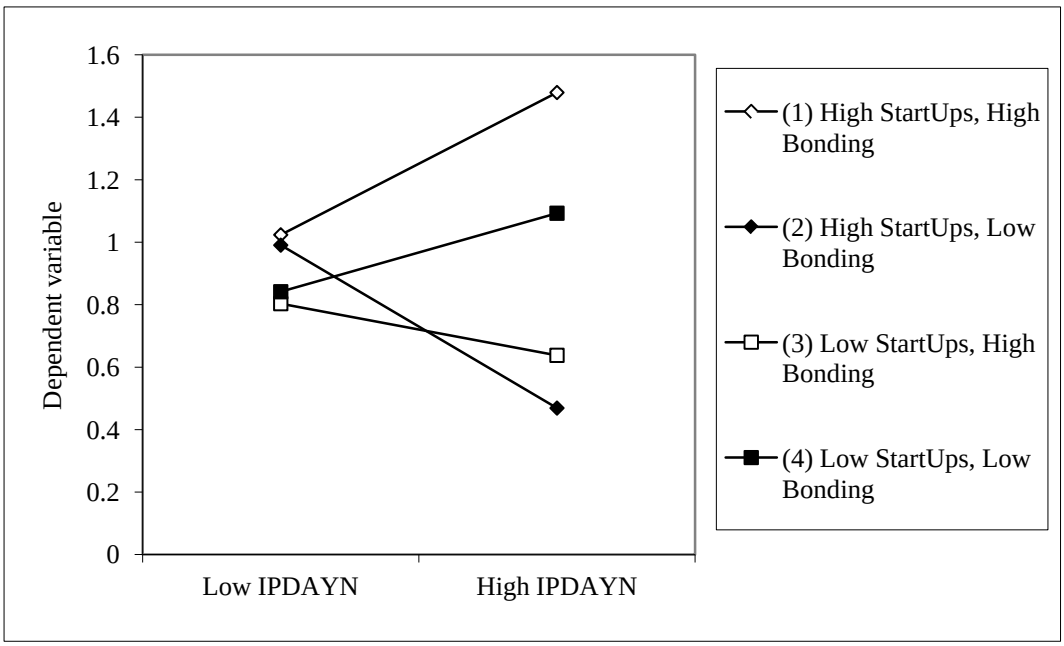
Those with lower levels of advice made more changes in the high technology environment: perhaps less forgiving than low technology environments?



Going from low to high IPDAYN, if external advice and international experience were mixed, then BMA increased. If, however, experience and advice were matched (ie both high, or both low) BMA fell.



Going from low to high IPDAYN, if general management experience and GlobalSC were mixed, then there was more BMA and *vice versa* if they are matched (ie both high, or both low). In the low technology environment, social capital was the differentiator.



Degree of bonding had the opposite effect, depending on start-up experience. Going from low to high technology environments, those with more start-up experience engaged in more change with higher bonding, but less change with lower bonding: an amplifying effect. For those with less start-up experience, the bonding impact was reversed: a stifling effect.

DISCUSSION

The findings of this study suggest that human capital, social capital and technology environment influence BMA in new ventures. But they do so in nuanced, subtle ways. For example, education levels have no effect on their own. They have no effect in conjunction with social capital. They come into their own, however, when bundled together with external advice and technology environment. Similarly, general management experience was insignificant on its own and in two-way interactions. But bundled with GlobalSC and technology environment it made a statistically significant contribution. Configurational effects trumped both universal and contingent effects.

Implications for theory

Our finding in support of a configurational approach to BMA is consistent with the view that scholars could usefully apply it more broadly for description and prediction in organisation studies. We ran hierarchical regressions using three-way interactions. The CAUSEE database allows scope for the same regressions to be run on sub-samples, to drill deeper for greater understanding. Other methods can be used, in order to describe and analyse combinations of variables.

For the purposes of testing the robustness of our results, we ran the same regressions using two other measures of technology environment. There were significant configuration effects in each operationalisation of technology environment. Further, the number of significant configurations increased as firms moved from having a major R&D focus, to considering themselves hi-tech, to having already applied for IP protection or developed proprietary technology/processes. Two configurations were statistically significant for two of the operationalisations: IPDAYN, general management experience, GlobalSC; IPDAYN, international experience, external advice. These supplementary analyses provide further support for the configurational approach in the context of BMA.

Several results were contrary to our hypotheses.

Prior managerial experience in large corporations was positively associated with BMA. One potential explanation could be that these entrepreneurs had learnt about the dangers of inertia from that experience. It could also be that these entrepreneurs had left the large organisations precisely because they were more suited to the more dynamic new venture environment.

The lack of positive joint effect of IPDAYN with any of the social capital or human capital variables remains puzzling, but we must admit it is consistent with the literature.

We hypothesised that BMA would highest when all three elements of the configuration were higher, in a sense feeding on each other. Instead, although BMA was always highest in the higher technology environment, the other elements were generally not both high. This confirms that generalisations are not always useful. More subtle interactions were possibly at play, reinforcing the argument for introducing more variables. There might be cognitive or other limits to having every element at high levels (Delmar and Shane 2006; Pierce and Aguinis 2013). The effect of combining high IPDAYN, bonding and prior start-ups is consistent with the story of supportive internal networks [eg H1c] but why should it be so different in hi-tech? In analysis not reported here, we found very similar patters when combining IPDAYN, high GlobalSC and bonding.

Implications for practice

Our findings suggest that, although different combinations can have different effects, networking and seeking advice outside the firm is generally useful for the purposes of aiding BMA. In a prior version of this paper (Dottore 2013), we added: "but avoid family and friends." The more nuanced analysis conducted here shows that statement was probably wrong. Our findings underscore the value of taking a systems thinking approach: those family and friends can be very useful, if you share prior start-up experience and are creating a NTBF.

It is also generally useful to have had experience – of business and of the world at large – before starting a new venture. Education providers might wish to adapt their courses, to include greater proportions of experiential learning. Service providers (eg banks, legal and accounting firms) can contribute by bringing together clients who might learn and find support from each other. Policymakers should encourage relevant networking activities, if none exist due to market failure.

Implications for further research

In this study, we presented research on the combined business model. It is possible that different elements could behave differently. As a result, it will be useful eventually to conduct studies with greater granularity. The importance of social capital suggests that extroverts and boundary spanners (Tushman and Scanlan 1981; Janowicz-Panjaitan and Noorderhaven 2008) have an important role to play. This relates to the extent of external orientation displayed by the firm and its members. Given that it reflects learning and the results of experimentation, it would be interesting to know if the relative distance from prior human capital has a bearing on BMA.

Our findings suggest scope for research beyond three-way interactions (Miller 1996) and for continuing the unbundling of SC and HC.

Our design ensures high population validity for new ventures in Australia and is theory-accretive, which is rare in business model research. The results, therefore, though very promising are relevant to that geographic context. As a result, there would be considerable practical and research value created by conducting similar studies in other countries.

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Appendix

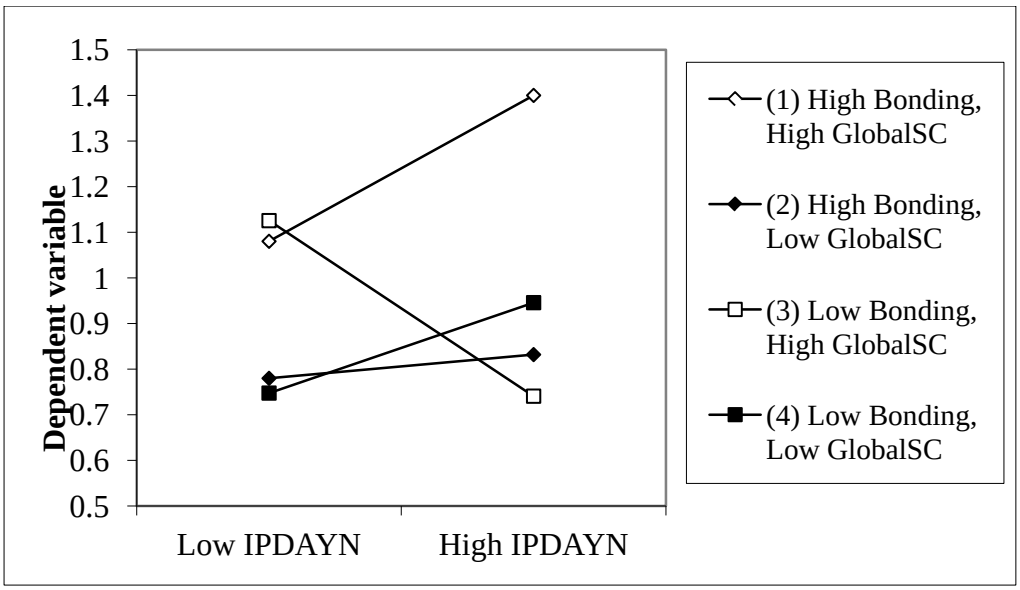
	Social Capital	Gen Educn	Spec Educn	GenExp	Spec Exp
Controls					
Constant	.91***	.91***	.91***	.91***	.91***
Product/Service	-.27**	-.28**	-.27**	-.27**	-.27**
Female Owners %	.00	.00	.00	.00	.00
Age Youngest	-.01	-.01	-.01	-.01	-.01
Age Oldest	.00	.00	.00	.00	.00
No of Owners	.00	.00	.00	.00	.00
Step R^2 change	.04**	.04**	.04**	.04**	.04**
Social Capital					
Bonding ties	.00	.00	.00	.00	.00
Global SC	.13***	.13***	.13***	.13***	.13***
Ext Advice	.02*	.02*	.02*	.02*	.02*
Step R^2 change	.07***	.06***	.07***	.07***	.07***
Human Capital					
GenEducn		.01			
Step R^2 change		.00			
Same Indy Exp					.00
FirmWorkExp					.03*
Start-ups					.03*
Step R^2 change					.03**
BusEducn			.02		
Step R^2 change			.01		
GenMgmtExp				.00	
LgeCorpExp				.25**	
IntlExp				.03*	
Step R^2 change				.03**	
IP Developed or Applied	.05	.06	.03	-.01	.00
Step R^2 change	.00	.00	.00	.00	.00
Interaction terms					
Global SC*Bonding	-.02				

ExtAdvice*Bonding	-.03†				
Step R^2 change	.01				
GenEducn*SC Step R^2 change		.01			
BusEducn*SC Step R^2 change			.00		
IntlExp *SC Step R^2 change				.01	
GenMgmtExp *SC Step R^2 change				.01	
LgeCorpExp *SC Step R^2 change				.01	

	Social Capital	Gen Educn	Spec Educn	GenExp	SpecExp
Start-ups*SC Step R^2 change					.00
Same Indy Exp *SC Step R^2 change					.03**
FirmWorkExp *SC Step R^2 change					.01
IP*Bonding Step R^2 change	.00				
IP*GlobalSC Step R^2 change	.00				
IP*ExtAdvice Step R^2 change	.01*				
IP*SC Step R^2 change		.02†	.02*	.02*	.02*
IP*GenEducn Step R^2 change		.00			
IP*BusEducn Step R^2 change			.00		
IP*GenExp Step R^2 change				.00	
IP*SpecExp Step R^2 change					.01
IP*GlobalSC*Bonding Step R^2 change	.01†				
IP*ExtAdvice*Bonding Step R^2 change	.00				
IP*GenEducn*Bonding Step R^2 change		.00			
IP*GenEducn*GlobalSC Step R^2 change		.00			
IP*GenEducn*ExtAdvice Step R^2 change		.01*			
IP*BusEducn*Bonding Step R^2 change			.01		
IP*BusEducn*GlobalSC Step R^2 change			.00		

IP*BusEducn*ExtAdvice Step R^2 change			.00		
IP* IntlExp *SC Step R^2 change				.03**	
IP* GenMgmtExp *SC Step R^2 change				.02*	
IP* LgeCorpExp *SC Step R^2 change				.01	
IP*Start-ups*SC Step R^2 change					.02*
IP*SameIndyExp*SC Step R^2 change					.00
IP*FirmWorkExp *SC Step R^2 change					.00
Model statistics					
R^2/ $AdjR^2$	.14/.10	.15/.10	.15/.10	.25/.17	.23/.15
Total Model *F*	3.68***	3.12***	3.06***	3.13***	2.88***
N	378	377	378	375	376
† $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$					

Appendix B


1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
Dependent variable
Low IPDAYN
High IPDAYN
(1) High Bonding, High GlobalSC
(2) High Bonding, Low GlobalSC
(3) Low Bonding, High GlobalSC
(4) Low Bonding, Low GlobalSC